International Journal of Civil Engineering and Technology (IJCIET)
Volume 8, Issue 3, March 2017, pp. 1070–1076 Article ID: IJCIET_08_03_109
Available online at http://www.iaeme.com/IJCIET/issues.asp?JType=IJCIET&VType=8&IType=3
ISSN Print: 0976-6308 and ISSN Online: 0976-6316

SEISMIC ANALYSIS OF FRAMED STRUCTURES WITH AND WITHOUT FLOATING COLUMNS

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ABSTRACT

The multi-storey buildings in urban cities are required to have column free space due to shortage of space, population and also for aesthetic and functional requirements. In order to have more area for parking space and for other amities, concept of floating columns in multi-storey framed structure is becoming popular stability used structural integrity of such structures while resisting earthquake becomes critical. For this buildings are provided with floating columns at one or more storey. In this Equivalent static method, response spectrum and time history method were used for analysis in ETABS-2015. Software was used and structure was assumed to be situated in earthquake Zone III. And the parameters like Base shear, Storey drift, and Displacement were evaluated.

Key words: Floating Columns, Storey Drift, Response Spectrum and Time History.

Cite this Article: SK. Abdul Rehaman and M. Suresh Babu, Seismic Analysis of Framed Structures with and without Floating Columns. *International Journal of Civil Engineering and Technology*, 8(3), 2017, pp. 1070–1076.
http://www.iaeme.com/IJCIET/issues.asp?JType=IJCIET&VType=8&IType=3

1. INTRODUCTION

A column is supposed to be a vertical member starting from foundation level and transferring the load to the ground. The term floating column is also a vertical element which ends (due to architectural design/ site situation) at its lower level (termination Level) rests on a beam which is a horizontal member**.** Buildings with columns that hang or float on beams at an intermediate storey and do not go all the way to the foundation, have discontinuities in the load transfer path. The beams in turn transfer the load to other columns below it. Such columns where the load was considered as a point load**.**

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behavior of a building during earthquakes depends critically on its overall shape, size and geometry, in addition to how the earthquake forces are carried to the ground. The earthquake forces developed at different floor levels in a building need to be brought down along the height to the ground by the shortest path any deviation or discontinuity in this load transfer path results in poor performance of the building.

Buildings with vertical setbacks (like the hotel buildings with a few stores wider than the rest) cause a sudden jump in earthquake forces at the level of discontinuity. Buildings that have fewer columns or walls in a particular storey or with unusually tall storey tend to damage or collapse which is initiated in that storey. Many buildings with an open ground story intended for parking collapsed or were severely damaged in Gujarat during the 2001 Bhuj earthquake. Buildings with columns that hang or float on beams at an intermediate storey and do not go all the way to the foundation, have discontinuities in the load transfer path.

For a hotel or commercial building, where the lower floors contain banquet halls, conference rooms, lobbies, show rooms or parking areas, large interrupted space required for the movement of people or vehicles. Closely spaced columns based on the layout of upper floors are not desirable in the lower floors. So to avoid that problem floating column concept has come into existence. In urban areas, multi storey buildings are constructed by providing floating columns at the ground floor for the various purposes which are stated above. These floating column buildings are designed for gravity loads and safe under gravity loads but these buildings are not designed for earthquake loads. So these buildings are unsafe in seismic prone areas.

2. MODELING AND BUILDING DATA

2.1. Without Floating Columns

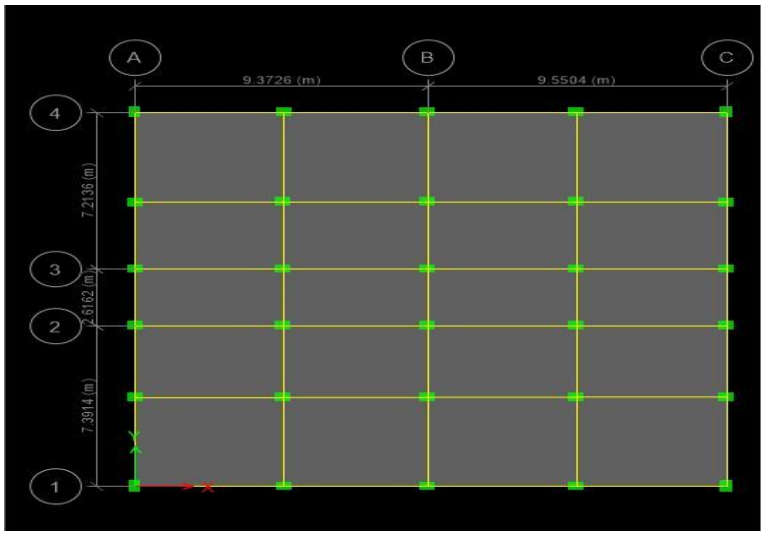

Figure 1 Plan of the building without floating columns

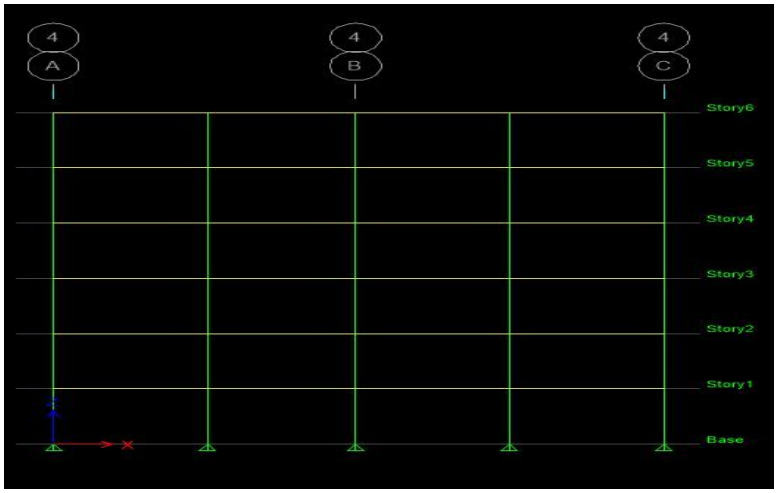

Figure 2 Elevation of the building without floating column

2.2. With Floating Columns

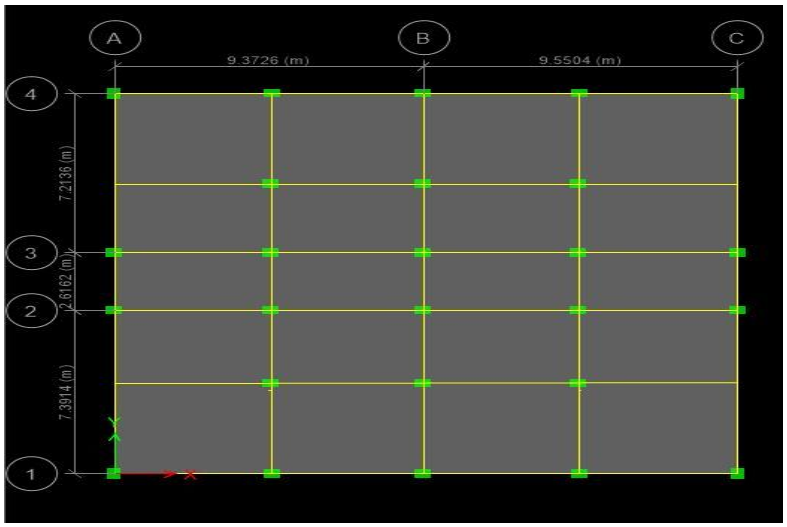

Figure 3 Plan of building with floating column

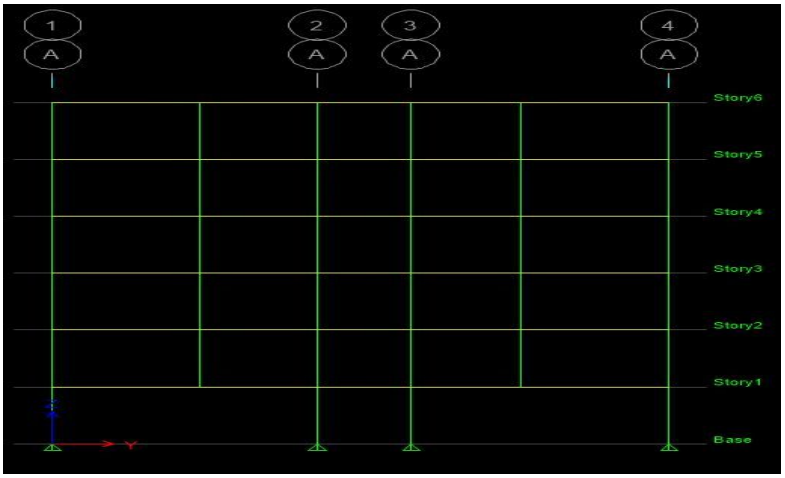

Figure 4 Elevation of building with floating column

2.3. Building Data

Table 1 Building data and Dimensions

Plan Dimension/Plinth Area		19mx18m
Total Site Area		809.66 Sq.m
No of storey's		G+5
Total Built up Area		1710 Sq.m
Each storey height		3m
Thickness of external wall		230mm
Thickness of internal wall		115mm
Thickness of parapet wall		115mm
Thickness of slab		125mm
Floor finish		1 KN/m^2
Live load on floors		2.5KN/m^2
Live load on roof		2KN/m^2
Density of concrete		25 KN/m^3
Density of brick		20 KN/m^3
Grade of concrete (f_{ck})		M25
Grade of steel (f_y)		Fe 500
Without floating column	Beam	230mmx425mm
	Column	230mmx550mm
With floating column	Beam	400mmx400mm 400mmx450mm
	Column	400mmx550mm 500mmx500mm

3. RESULTS

EQ = Earthquake, RS = Response Spectrum and TH = Time History.

3.1 Base Shear

Table 2 Base shear

Model	**Without Floating column**	**With Floating column**
Base shear in KN (EQ)	2072.01	2284.5
Base shear in KN (RS)	2277.69	2699.4
Base shear in KN (TH)	2486.416	2786.56

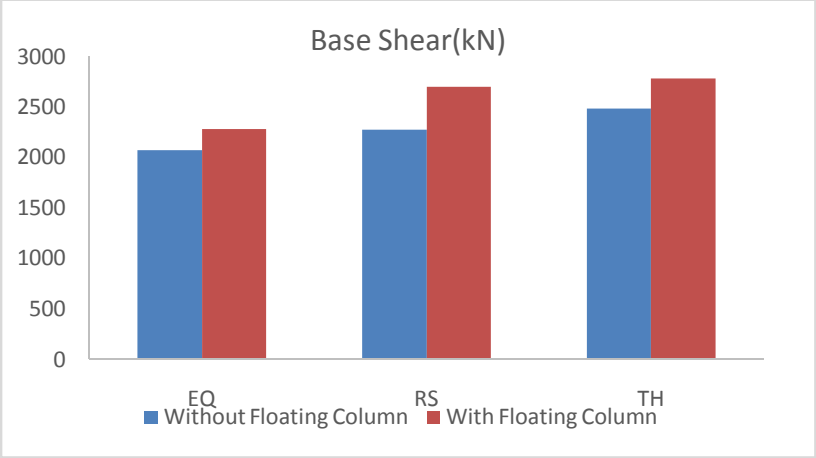

Figure 5 Base Shear With and Without Floating Column

3.2. Storey Drift

Table 3 Storey Drift

Model	Without floating column	With floating column
Storey Drift in mm (EQ)	1.9	8.54
Storey Drift in mm (RS)	1.57	10.54
Storey Drift in mm (TH)	5	11.36

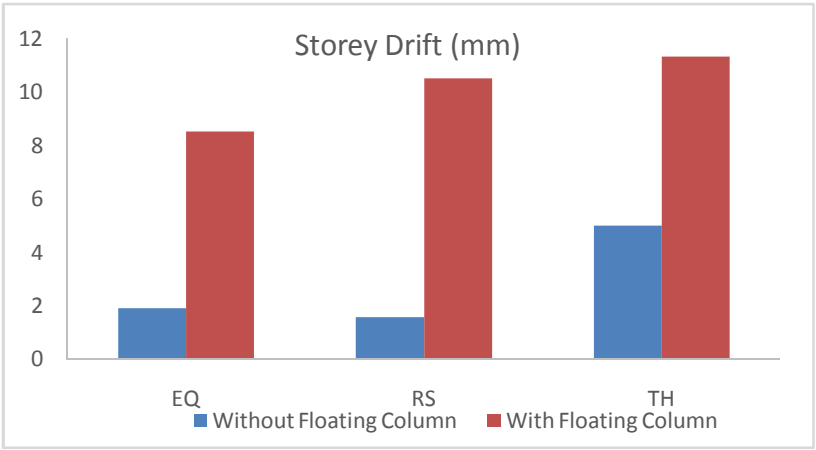

Figure 6 Storey Drift With and Without Floating Column

3.3. Displacement

Table 4 Displacement

Model	Without floating column	With floating column
Displacement in mm (EQ)	1	15.4
Displacement in mm (RS)	8.5	55.4
Displacement in mm (TH)	33	64

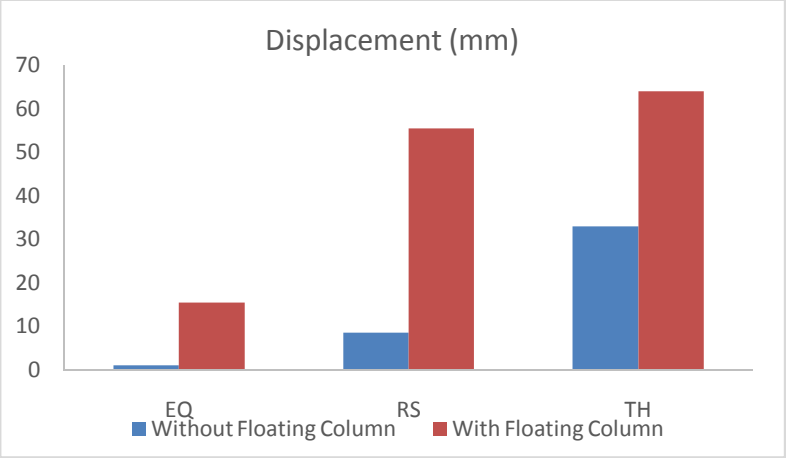

Figure 7 Displacements With and Without Floating Column

4. CONCLUSION

Following are the conclusion in the case of seismic analysis of G+ 5 framed structures with and without floating column.

- In this both methods without floating column performed better compared to floating column.
- Equivalent static method of analysis presents lowest value of displacement for multi-storey building without floating column.
- Response spectrum analysis presents lowest values of storey drift for multi-storey building without floating column.
- So floating columns are difficult in earthquake zones.

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